A scrambling method based on disturbance of motion vector

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ABSTRACT

Multimedia data security is very important for multimedia commerce on the Internet such as "pay-per-view" services. Thus, watermarking algorithms for data security appear. These algorithms describe methods and technologies that allow information to be hidden, for example a number or text, into a media, such as images, video, audio files... In this paper, we propose a new application of watermarking based on a scrambling process. In this application, we develop a waterscrambling technique in which video data are scrambled efficiently by disturbing a subset of motion vectors. The interest of this approach is its ability to scramble a video while maintaining a certain visibility. Effectively it permits the use of considerable levels of security in order to choose the level of perceptibility of the video. By using watermarking techniques we will be able to combine this approach with a classical copyright watermarking system.

Keywords
Waterscrambling, Watermarking, Motion Vector.

1. INTRODUCTION
Until now, most watermarking systems were designed to protect a media content by inserting robust copyright. Our approach is slightly different. Indeed we use watermarking techniques to insert a visible mark in order to scramble a video content. On one hand, video scramblers are commonly employed to prevent unauthorized access to video data, a scrambling system is presented in [2]. Several video scrambling systems rely on methods of directly distorting the data such that without descrambling the video appears unintelligible to a viewer. These techniques are not efficient for transmitting completely digital video signals because they change the statistical properties of the original video itself, thus making it very difficult to compress. Another drawback concerns the fact that the video can not be read.
In this paper our objective concerns the integration of our

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process in an access control system which provides for example movies on the Internet. It lies on the border between "access-control system" and "watermarking system" by offering degraded but visible video on the Internet. This system permits to put scrambled videos on the Internet, video provider doesn't need to have different versions of the same video (a degraded one for preview and an original one for sales). They do not need to have a secure system to store the video on storage disk, the protection is on the video. Moreover it offers a scrambling process that can determin the video quality while maintaining the video visibility and disturbs less the statistic of the video, thus it's not difficult to keep the level of compression.

Few articles tackle the problem. An access control system based on fractal coding has been presented in [4]. The author uses a compression scheme based on fractal coding to partially encrypt an image. Their approach is a type of adaptative encryption scheme. Our approach is more flexible, we have more of a level of distortion, it is easy to implement and its a real time process. Moreover, we will combine our system with a watermarking system by combining the embedding of a two part mark in the motion vector.

For the scrambling, we use small modifications of motion vectors. Previous works on insertion of a watermark in motion vector are presented in [3] and in [5]. In these two papers, the watermark is invisible and the purpose is not the same. They insert copyright, they do not scramble the content. For these two articles, the difference is the insertion rule used. For both, they obtain the motion vectors from a mpeg stream, then they randomly select a block per frame and watermark it. In the first one, they use a parity rule to embed two bits of the mark in each motion vector (horizontal component and vertical component). In the second one, they embed the watermark in the macroblocks which are in the largest motion vector magnitude, and they select the motion vector component which will cause least distortion in motion vector phase angle. This two methods are not reversible methods which is a problem when reconstructing the original video as we need it for our concept.

Experimental results and discussions are presented in section 2. Finally section 3 provides some concluding remarks.

2. PROPOSAL FRAMEWORK
In this section, we propose to describe our waterscrambling process. Our digital video waterscrambling systems aims to meet the objectives outlined above. *Figure 1* shows a general architecture of our system. At the encoder, the input video signal is compressed by MPEG4 or 2 codec, thus a syntactic analyzer detects motion vectors in order to insert a visible

watermark in a subset of them according to an insertion rule described later. On the decoder side the same process of extracting motion vectors is applied and the dual rule of the insertion rule is used to reconstruct the video. Only the scramble module is implemented and will be presented in the demo, the access control part is not yet implemented, we focus on the use of watermarking technique. But generally, a scramble process is a part of an access control system, it's the reason why we introduce the principle of access control and the scheme of the key transmission.
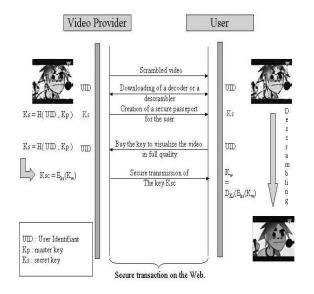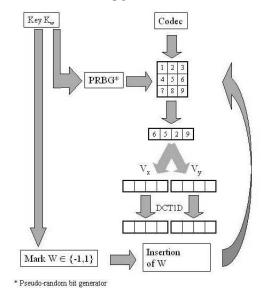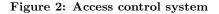

Figure 1: Access control system

2.1 Scrambling and descrambling scheme

The scrambling procedure is included in a compression scheme. The codec we use is a mpeg4 codec. The first step consists of extracting the set of motion vectors to be scrambled. Two different concepts can be developed. The first one uses a syntactic analyzer and thus the waterscrambling system is an independent module. The second one consists of modifying the motion vectors directly in MPEG codec. Because of that, we can use a compliant module with a standard codec. System overview is described in *Figure 2*. We can scramble directly on a compressed stream or in an uncompressed domain by using a motion estimator and then make a motion compensation which produce a slightly degraded video. The mark is a binary vector $W \in \{1, -1\}^n$ (n is the size of the mark) which is spread via a classic technique of spread spectrum introduced by Cox [1]. For each frame, the mark is permutated in order to increase the robustness of this system and added to a set of motion vectors at each frame. To add W, we put motion vectors in a global vector V, we flush it by using a pseudo random generator initialized by a user key 'k' which is also the watermark to be inserted. Thus, we make two DCT 1D, one on the X components of V and the other one on the Y components in order to insert the mark in the frequency domain. The interest of this scheme is the spreading of the mark on all the vector selected. Thus we determine a level of scrambling by adjusting a coefficient α which is choosen by the provider (the level of scrambling must be known by the user in order to correctly reconstruct the original video) and then we scramble the DCT coefficient in a reversible way. Finally we reconstruct the video with these new scrambled vectors to obtain a scrambled version of the original video. The insertion rules are described in

Figure 3.   The scrambling procedure is reversible.

Figure 2: Access control system

$$If\ W_i = -1\ then$$
$$Dct(V_y^i) = Dct(V_y^i) + f(\alpha, W_i, K_w)$$
$$else$$
$$Dct(V_x^i) = Dct(V_x^i) + f(\alpha, W_i, K_w)$$

Figure 3: Insertion rule

3. CONCLUSION & PERSPECTIVE

We have presented a new application of watermarking which is called waterscrambling, this approach will could be combined with a pure watermarking application to embed in the video a robust copyright, and the two marks could be correlated to increase robustness of the system.

4. REFERENCES

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